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## **Canister System Design Development Plan**

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**Canister System Design Development Plan**

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## ACRONYMS

BSC	Bechtel SAIC Company, LLC
BWR	boiling water reactor
CFR	Code of Federal Regulations
CSNF	commercial spent nuclear fuel
DOE	U.S. Department of Energy
DDP	design development plan
HLW	high-level radioactive waste
ITS	important to safety
NRC	U.S. Nuclear Regulatory Commission
NSDB	<i>Nuclear Safety Design Bases for License Application</i>
PWR	pressurized water reactor
RFP	request for proposal
SAR	Safety Analysis Report
SSCs	structures, systems, and components
SNF	spent nuclear fuel
YMP	Yucca Mountain Project
YMR	Yucca Mountain Repository

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## 1. PURPOSE

This design development plan (DDP) identifies major milestones for advancing the design of disposable canisters containing bare fuel, metal overpacks for the disposable canister, and concrete overpacks for the disposable canisters. The DDP identifies means of demonstrating that the disposable canister and overpack systems will meet their credited safety functions at the repository. An "overpack system" is any combination of canister and overpack discussed in this plan.

Spent nuclear fuel (SNF) and high-level radioactive waste (HLW) arriving at the repository that is not yet ready for loading into waste packages is managed by placing it in the aging system. Aging is needed to allow some commercial SNF (CSNF) to cool to meet the thermal limits for emplacement. DOE SNF and DOE HLW are aged to assist in thermal management of emplacement drift loading. This DDP identifies the means of demonstrating that:

- Existing overpack systems licensed in accordance with 10 CFR 72 [DIRS 173336] can be relied upon to perform the important to safety (ITS) functions identified in *Nuclear Safety Design Bases for License Application* (BSC 2005 [DIRS 171512]).
- Disposable canister and overpack systems that will be licensed to 10 CFR 63 [DIRS 173273] can be relied upon to perform ITS functions identified in the *Nuclear Safety Design Bases for License Application* (BSC 2005 [DIRS 171512]).

A glossary of terms, for items such as "aging cask," "overpack", and "disposable canister," is found in Appendix A. References and source documents used in this plan are listed in Section 11.

## 2. SCOPE AND OBJECTIVE

The scope and objective of this plan are to present a path forward for engineering, licensing, procurement, and placement into service of disposable canisters and overpacks at the Yucca Mountain repository site.

### 2.1 Applicability

This plan applies to:

1. A YMR disposable canister developed specifically to be loaded at Yucca Mountain, see Figure 6-1,
2. A concrete overpack to house the disposable canister on an aging pad, see Figure 4-1,
3. A metal overpack to house the disposable canister on an aging pad, see Figure 4-2.

## 2.2 Scope

This DDP describes the path forward for DOE to:

1. Ensure that technology and industry practices used for 10 CFR 72 [DIRS 173336] canister, transfer casks, and overpack system designs are adequate for similar systems designed to the requirements of 10 CFR 63 [DIRS 173273].
2. Ensure that the design of the disposable canister and internal basket meets the requirements for underground emplacement of SNF.
3. Provide the path forward to demonstrate satisfaction of the requirements listed in the nuclear safety design bases (NSDB) report (BSC 2005 [DIRS 171512]) for those disposable canister and overpack systems listed in Section 2.1.

This plan also identifies gaps, if any, that exist between current industry codes and standards and current industry practices compared to the planned standards and practices at Yucca Mountain. The gap analysis, presented in Section 5, concludes whether or not a structure, system or component (SSC) is considered standard or nonstandard. The scope of the gap analysis in Section 5.0 identifies whether SSCs are readily available or not, and identifies if SSCs are currently utilized in the nuclear industry. This plan discusses how the project can "bridge-the-gap" between what has been accomplished already with currently available commercial casks, and what the repository needs to do for placing disposable canisters and overpacks into service at Yucca Mountain.

The project has a research and development program to resolve safety questions for those SSCs that have been identified as being safety related and that need additional work to resolve the safety questions. The requirements for the program are described in the *Yucca Mountain Review Plan, Final Report* (NRC 2003 [DIRS 163274], p. 2.3-1). Since the disposable canisters are similar to existing systems and the gaps in information are known, the system is not currently a candidate for inclusion in the formal research and development program required by the *Yucca Mountain Review Plan, Final Report* (NRC 2003 [DIRS 163274], Section 2.3). However, this does not preclude inclusion of disposable canister development work in the Yucca Mountain research and development program in the future if, for any reason, the U.S. Nuclear Regulatory Commission (NRC) requires substantial new information.

## 2.3 Objectives

The primary objectives of this design development plan and the proposed path forward are:

- Demonstrate that commercial dual-purpose canisters and overpack systems currently licensed under 10 CFR 72 [DIRS 173336] can, with minimal modifications and building on the current repository waste package design, be made to comply with 10 CFR 63 [DIRS 173273] requirements, and can be relied upon to meet ITS functions for DOE disposable canisters, handling casks, and overpacks.
- Demonstrate, through evaluation of currently licensed commercial casks and overpack systems at Independent Spent Fuel Storage Installations, that the existing technology

and present industry practices are adequate to satisfy the repository aging and emplacement (disposable canister only) functions under the repository design operating conditions for disposable canisters and overpack systems.

- Demonstrate that disposable canisters and overpack systems licensed under 10 CFR 63 [DIRS 173273] can be relied upon to meet their ITS function.

### 3. QUALITY ASSURANCE AND COMPUTER SOFTWARE

This plan is subject to project requirements that require that quality assurance and computer software issues be addressed during execution of the work. The following sections summarize the quality assurance determination and software requirements.

#### 3.1 Quality Assurance

This document was prepared in accordance with LP-ENG-014-BSC, *Engineering Studies* [DIRS 168862]. The results of this document are only to be used as the basis for selection of applicable codes and standards and are not to be used directly to generate quality-affecting products. Therefore, this engineering study is not subject to requirements of the *Quality Assurance Requirements and Description* (DOE 2004 [DIRS 171539]) document.

The scope of this DDP includes the presentation of a plan for components that are credited in the repository safety case analysis. Design and development of these components will be accomplished by the implementation of planning, analysis, and possibly testing that will be accomplished in accordance with the *Quality Assurance Requirements and Description* (DOE 2004 [DIRS 171539]) document.

#### 3.2 Computer Software

The only computer software used in this study (Microsoft Word) is classified as exempt from LP-SI.11Q-BSC, *Software Management* [DIRS 171923]. All software used to prepare this analysis is listed in LP-SI.11Q-BSC, Section 2.1, as "software not subject to this procedure."

### 4. FUNCTIONAL DESCRIPTION

The function of a disposable canister, in conjunction with an overpack, is to provide heat transfer path, environmental protection, radiological shielding, and criticality control for commercial SNF. The YMP disposable canisters are designed to allow loading of bare fuel at the repository, placement into an overpack, aging at the aging pad in a vertical orientation, and then placed inside a waste package for final subsurface disposal.

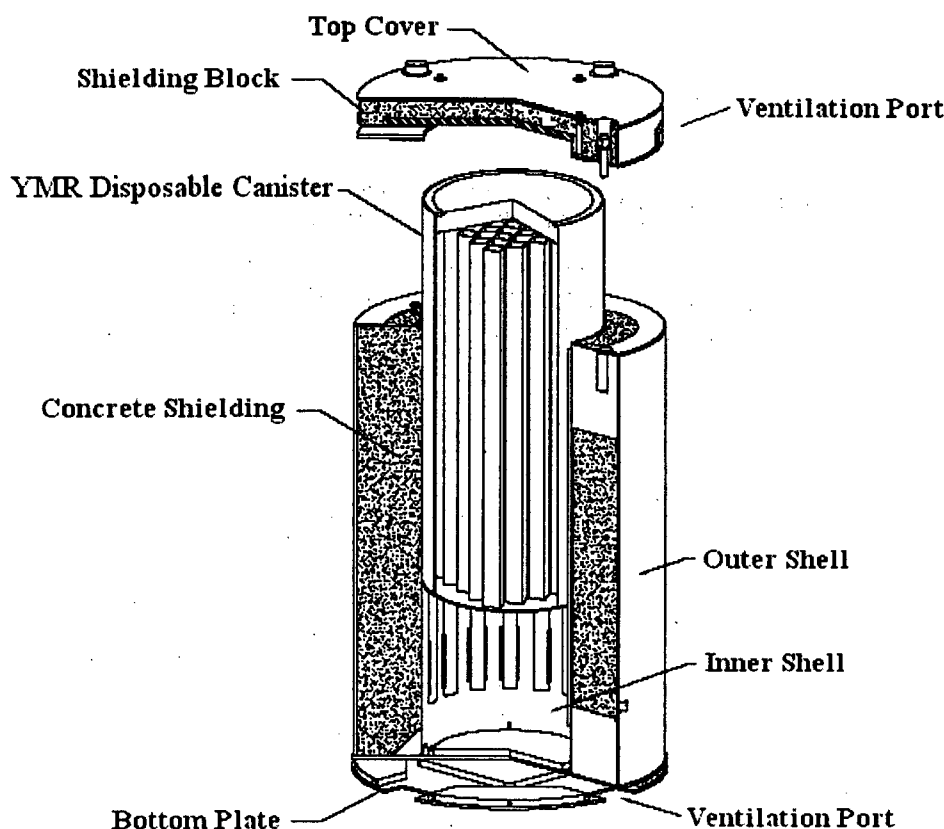
#### 4.1 Disposable Canister Function

Commercial uncanistered SNF is transferred at the Fuel Handling Facility or the Dry Transfer Facility to waste packages for immediate underground emplacement, or, if the thermal output exceeds that allowed for emplacement, to a disposable canister for placement in a vertical overpack for aging. When the SNF has thermally reached an acceptable thermal output for emplacement the disposable canister will be returned to the Dry Transfer Facility, Fuel Handling

Facility, or Canister Handling Facility to be transferred to a waste package. The YMR disposable canister will be sized differently than existing canister systems to accommodate the requirements for both aging and emplacement. The structures, systems, and components, however, are expected to be similar to those shown in Figures 4-1 and 4-2. The function of the canister is to provide a permanent radiological containment boundary for commercial SNF during the aging process and subsequent transfer to a waste package. After commercial SNF is placed in a disposable canister and the canister is sealed, subsequent contamination potential of the handling facilities or the canister overpack is greatly reduced.

## 4.2 Overpack Function

Figures 4-1 and 4-2 show existing overpacks used commercially. The function of the metal or concrete overpack is to provide a robust radiological containment boundary and environmental protection to the SNF during the aging process. Overpacks protect the internal disposable canister from tornadoes, tornado missiles, and other extreme natural phenomena.



Source: HOLTEC International 2002 [DIRS 168494]

Figure 4-1. Disposable Canister in Concrete Overpack

This figure is based on *Final Safety Analysis Report for the Holtec International Storage and Transfer Operation Reinforced Module Cask System, Hi-Storm 100 Cask System* (HOLTEC International 2002 [DIRS 168494]).

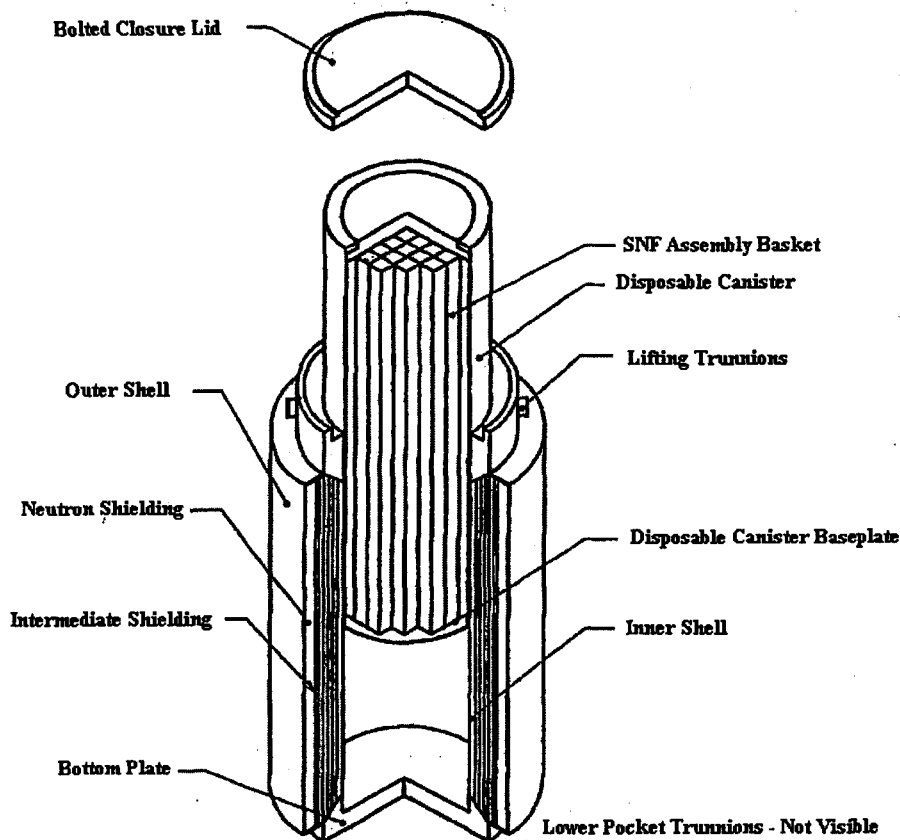


Figure 4-2. Disposable Canister in Metal Overpack

This figure is derived from information in the *Final Safety Analysis Report for the Holtec International HI-STAR 100 Storage Cask System* (Gutherman 2003 [DIRS 169235])

## 5. STANDARD AND NONSTANDARD SSCs

For the purpose of the “gap” analysis disposable canisters are characterized as standard SSCs or nonstandard SSCs. Standard SSCs are items that are currently in use at nuclear facilities, have a proven track record, and pose relatively low risk in their application for use at Yucca Mountain. Nonstandard SSCs are those items that are unique to the repository and have not been developed or placed into service previously at other locations. Usually nonstandard SSCs have some precedent for their design and operation, but they have not been fully developed and integrated into a complete system. It is expected that there will only be minor modifications required to dual-purpose canister and overpack systems to bridge the gap between a nonstandard canister and the standard canister to meet the performance objectives for use at Yucca Mountain. Disposable canisters with extremely higher allowable burn-up and thermal loading than those currently identified are not part of this design development plan and will be addressed in the future.

This plan presents the disposable canister system gap analysis in Table 5-1, Disposable Canister System Gap Analysis, for canister and overpack systems. The table summarizes the commercial availability of the components and the forward looking design development strategy for site-specific disposable canisters and overpack systems. The information in Table 5-1 is primarily based on the report *Evaluation of 10 CFR 72 Licensed Casks for Use in Aging Spent Nuclear Fuel* (Buchheit 2004 [DIRS 172766]).

Table 5-1. Disposable Canister System Gap Analysis

*SSC	Standard SSC		References for commercially available overpacks	Design Development Strategy
	Commercially Available	Established Practices, Codes, or Standards		
Concrete Overpack (Figure 4-1)	No	Yes	Buchheit 2004 [DIRS 172766], Table 1-2; HOLTEC International 2002 [DIRS 168494]	Site specific design to established practices, codes, standards, and NUREGs.
Metal Overpack (Figure 4-2)	No	Yes	Buchheit 2004 [DIRS 172766], Table 1-2; Gutherman 2003 [DIRS 169235]	Site specific design to established practices, codes, standards, and NUREGs.
Disposable Canister with Internal Basket (Figure 6-1)	No	Yes	BSC 2005 [DIRS 172973]	Site specific design to established practices, codes, standards, and NUREGs.

NOTE: \*See the Glossary in Appendix A for a detailed description of these SSCs.

Components in Table 5-1 are part of the repository preclosure system and are considered ITS. They do not have postclosure functions, with the exception of the internal basket, and are not important to waste isolation at the geologic repository. If on going studies indicate a need for a handling cask, it will be added when that need has been confirmed. A handling cask, if needed, provides radiological shielding of the disposable canisters during transfers within the waste handling facilities. The handling cask will be similar to existing commercial transfer casks used at the commercial storage facilities.

The primary structures, systems, and components of the SNF aging system are identified on the *Q-List* (BSC 2005 [DIRS 171190], Table A-1). The *Nuclear Safety Design Bases for License Application* (BSC 2005 [DIRS 171512]) identifies the nuclear safety requirements for SSCs that perform ITS functions. In all cases, ITS functions and requirements can be met using industry standard SSCs, and codes and standards developed specifically for nuclear applications. It is anticipated that the present procurement activities described in the scope of work document *Confirmation Report-Yucca Mountain CSNF Aging Casks* (BSC 2005 [DIRS 173420]) will confirm that established practices, codes, or standards are adequate to satisfy site-specific requirements. This procurement document requests consideration for the higher burn-up fuel of 60 GWD/MTHM, 4% initial enrichment for shielding calculations, and 5% initial enrichment for criticality calculations. Additionally a technical specification is planned which will list these fuel characteristics for the disposable canister and associated overpacks.

The containment portion of the canister will be developed utilizing the standard codes from industry as noted in Table 5-2, Disposable Canister Governing Codes. Specific exceptions to these codes, if needed, will be documented during the detailed design.

Table 5-2. Disposable Canister Governing Codes

Aging Canister	Applicable Codes	Editions/Years
General Requirements	ASME III, NCA	2004 Edition
Material Procurement	ASME III, NB-2000	2004 Edition
Design	ASME III, NB-3200	2004 Edition
Fabrication	ASME III, NB-4000	2004 Edition
Examination	ASME III, NB-5000	2004 Edition

This table is based on the Diablo Canyon Independent Spent Fuel Storage Installation (Womack 2001 [DIRS 172395], p. 4.0-1 and amended to use the current code edition). The table is subject to change and further review, but provides a starting point for design development.

As identified in Table 5-1 the non-standard disposable canister and overpacks systems are:

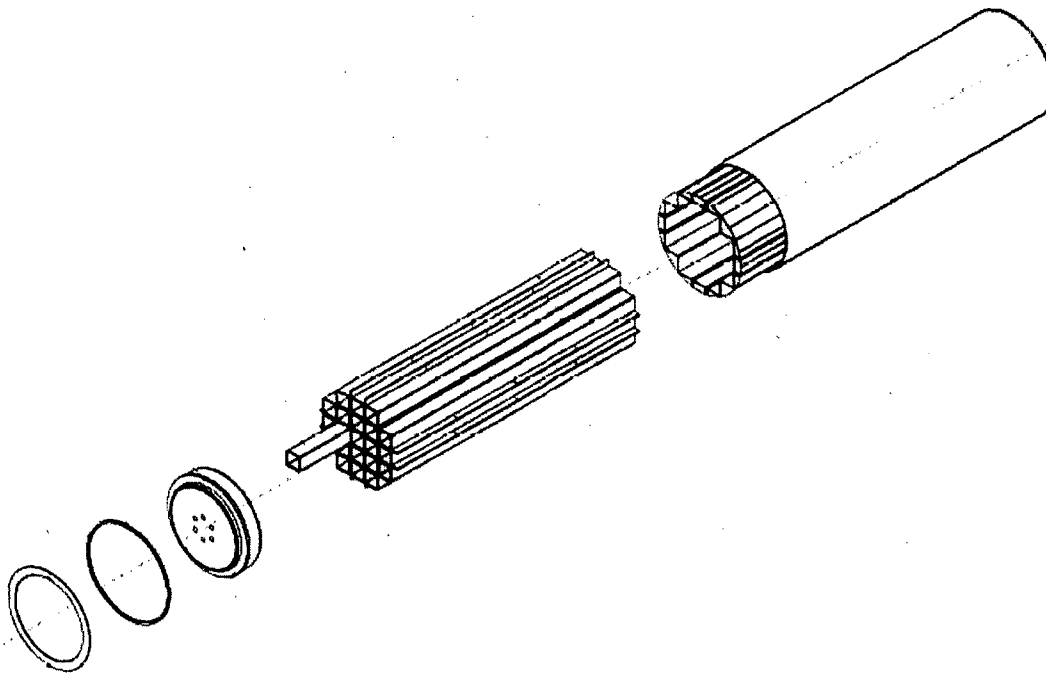
1. A newly designed disposable canister loaded at Yucca Mountain for aging uncanistered commercial SNF.
2. A newly designed metal aging overpack for the disposable canister.
3. A newly designed concrete aging overpack for the disposable canister.

The existing designs for the systems identified in Table 5-1 will provide the basis for the new designs for the non-standard disposable canisters and overpack systems.

## 6. DESIGN DEVELOPMENT ACTIVITIES

### 6.1 Commercially Available Overpack Systems

Significant design development work has been completed for the Yucca Mountain Repository (YMR) aging system and the disposable canister. In addition to *Requirements for the Site-Specific Canister/Basket* (BSC 2005 [DIRS 172973]) and the *SNF Aging System Description Document* (BSC 2005 [DIRS 172109]), other drawings of the disposable canister are listed in Appendix D of this report. Current design documentation will be amended with additional details as the design proceeds. The current design of the disposable canister system is shown in Figure 6-1.



Source: BSC 2005 [DIRS 173202]

Figure 6-1. Disposable Canister, 21-PWR Configuration

At this time three documents have been started or are completed that provide a preliminary technical basis for implementing existing systems at Yucca Mountain. They are:

- The preliminary evaluation report explained in Section 5, *Evaluation of 10 CFR 72 Licensed Casks for Use in Aging Spent Nuclear Fuel* (Buchheit 2004 [DIRS 172766]).
- The Yucca Mountain aging cask study *Aging Cask Study Submittal Item 1.1.1C, Letter Report - Evaluation on NRC Licensed Spent Fuel Storage Cask Systems with Respect to YMP Requirements* (Cogema 2004, [DIRS 173779]). This document is further discussed below.
- Confirmation from cask vendors that the casks in *Confirmation Report-Yucca Mountain CSNF Aging Casks* (BSC 2005 [DIRS 173420]). This document is further discussed below.

The comparative matrix is shown in *Aging Cask Study Submittal Item 1.1.1C, Letter Report - Evaluation on NRC Licensed Spent Fuel Storage Cask Systems with Respect to YMP Requirements* (Cogema 2004, [DIRS 173779]). This comparative matrix details the comparison of eight currently marketed metal casks and canister/overpack systems licensed under 10 CFR 72 and aging cask requirements as listed by the Aging SDD at that time. The summary of the study concluded that many of the requirements were met by all of the systems evaluated, but further

study is needed to confirm certain requirements are bounded by the cask's Final Safety Analysis Report conditions.

The design and fabrication of disposable canister and overpack systems will be based on a performance specification that ensures that the *Nuclear Safety Design Bases for License Application* (BSC 2005 [DIRS 171512]) requirements are satisfied. The site-specific performance requirements for the disposable canister will follow those provided in *Specification for the Procurement of Yucca Mountain Aging Casks* (TriVis 2005 [DIRS 173486]). The performance specification will be developed using the same requirements as outlined in *Engineering Services, SNF Aging Casks/Site-Specific Casks* (BSC 2004 [DIRS 172746]).

A technical basis review will be performed to compare performance of existing overpack systems licensed under 10 CFR 72 [DIRS 173336]) to Yucca Mountain site-specific requirements and conditions. These site-specific conditions include hazards and operating conditions (i.e. 50 year life, temperatures, seismic, and aircraft hazards, etc.); and their ability to comply with the requirements of 10 CFR 63 [DIRS 173273]. The review will include engineering calculations and analyses of criticality, shielding, structural, containment (per the 10 CFR 63.2 definition), and thermal performance using Yucca Mountain design basis fuel types and site-specific conditions. The consequences of a dry fuel transfer and overpack or disposable canister tip over, or slap down is also required. This review is currently underway and is further explained in *Confirmation Report-Yucca Mountain CSNF Aging Casks* (BSC 2005 [DIRS 173420]).

## **6.2 Summary of Calculations Pertinent to Canister and Overpack Systems**

The three previous documents (Buchheit 2004 [DIRS 172766]), (Cogema 2004 [DIRS 173779]), and (BSC 2005 [DIRS 173420]) document work that compares existing storage installations to the Yucca Mountain Repository requirements. In addition to these three documents various preliminary calculations have already been completed by BSC (as listed in Table 6-1) for criticality safety, worker dose, dose rates, and shielding. As the disposable canister design matures and systems are evaluated for implementation at Yucca Mountain additional calculations will be performed. Table 6-1, Disposable Canister System Calculation Summary provides a summary of the design calculations and responsible organization that are planned to support disposable canister design development. These calculations will demonstrate satisfaction of the Nuclear Safety Design Basis criteria (see Table 8-1) for the disposable canisters and overpack systems.

Table 6-1. Disposable Canister System Calculation Summary

Calculation	Description	Entity Performing Calculation
Structural	Examines seismic loads, tornado loads, drops, and other scenarios that could affect the structural integrity of the disposable canister with the associated overpack.	Cask Vendor
Thermal	Examines the thermal aspects of the disposable canister and the associated overpack to ensure that commercial SNF will remain within specified temperature limits during preclosure and postclosure operations.	Cask Vendor and BSC
Closure and Sealing	Reviews the process to close and seal the disposable canister, materials to be used, and closure configuration.	Cask Vendor and BSC
Safety and Performance	Reviews critical aspects that affect safety and performance.	Cask Vendor and BSC
Shielding	Evaluates the shielding characteristics of the system. Calculation continues work that was started and documented in <i>Shielding Evaluation for Spent Nuclear Fuel Aging Areas</i> (BSC 2004 [DIRS 169308]).	Cask Vendor and BSC
Criticality	Ensures that the design is criticality safe and meets the requirements in <i>Requirements for the Site-Specific Canister/Basket</i> (BSC 2005 [DIRS 172973]) and the NSDB [DIRS 171512]. This will be follow-on work from <i>Aging Facility Criticality Safety Calculations</i> (BSC 2004 [DIRS 171589]).	Cask Vendor and BSC
Dose Assessment	Calculation to ensure that worker doses are as low as is reasonably achievable. Calculation is follow-on work to present data currently documented in <i>Aging Facility Worker Dose Assessment</i> (BSC 2005 [DIRS 173167]).	Cask Vendor and BSC
Fire Hazard	Aging casks are discussed in <i>Site Fire Hazard Analysis</i> (BSC 2005 [DIRS 172174], Section 6.3.2). Additional analysis will confirm that the NSDB (Section 8) is satisfied when the canister system design is further advanced.	Cask Vendor and BSC

A fourth document, which will be a design performance specification, is planned to obtain a design for a disposable canister and associated overpack system. This performance specification will ensure that the *Nuclear Safety Design Bases for License Application* (BSC 2005 [DIRS 171512]) requirements are satisfied. Because of the dual-purpose nature of the canisters (storage and emplacement), a high level of interaction among DOE, BSC, and the design service subcontractor is expected.

### 6.3 Disposable Canister and Overpack Systems

A design procurement package will be created for the disposable canister and overpack system design. The successful qualified contractor for this design will perform the calculations described in Section 6.2. Design for a disposable canister for uncanistered CSNF and the metal or concrete overpacks will utilize existing technology described for commercially available overpacks. The disposable canister design will utilize existing commercial dual-purpose canister design data and design data developed for repository waste packages.

## 6.4 Benchmarking and Prototype Testing

Benchmarking is accomplished by comparing analytical results and physical characteristics of new designs to those of commercially licensed storage system. The comparison considers differences in design basis, performance requirements, environmental hazards, and external hazards.

An additional design development activity, prototype testing, has been identified that may be required to ensure compliance with the requirements and evaluations listed in this section and in Sections 7 and 8. Prototype testing may be required when the operational performance reports for the current 10 CFR 72 systems, or the newly designed disposable canister and overpack systems are completed and evaluated. For example, testing may be required to demonstrate that the 8 minute fire and temperature limit of 800° C, as specified for Yucca Mountain (BSC 2005 [DIRS 173420], Table 4-2), is attainable. Seismic analyses may also indicate that prototype testing of disposable canisters and overpack systems is needed. The need for testing will be developed after the technical performance evaluations are completed. Table B-1 presents a preliminary list of tests that may be performed to satisfy the NSDB requirements.

The schedule logic of completing the operational performance and the environmental and external event calculations and reports is presented in Section 9.0 of this report where the logic ties for future activities are presented. Definitive requirements for prototype testing will be identified after the evaluation of the systems are completed.

## 7. OPERATIONAL REQUIREMENTS AND DATA NEEDS

An objective of this design development plan is to demonstrate the functionality of the disposable canister and overpack systems ITS functions under representative operational conditions at Yucca Mountain. The design activities listed in Table 6-1 apply to the disposable canisters and overpack systems and their design at nuclear utilities and at Yucca Mountain. The work being conducted per *Confirmation Report-Yucca Mountain CSNF Aging Casks* (BSC 2005 [DIRS 173420]) will identify additional design requirements in the existing design which can be translated to any new design. The additional requirements presently identified are canister and overpack systems lift heights and the impacts from fuel with higher burn-up rates.

### 7.1 Disposable Canister and Overpack System Lift Heights

Drop heights and handling procedures at Yucca Mountain are the primary unique site-specific issues that have not been conducted and need to be addressed for the currently licensed canisters. A separate specification is being prepared to address drop heights for existing DPCs. Canisterized CSNF and aging casks containing bare CSNF at nuclear utilities have a variety of lift height specifications that are utilized during handling operations. Most handling at nuclear utilities is performed in pools and significant drops onto a dry surface are not possible. The technology for analyzing impacts to the canister and overpack when they have been dropped is proven and each existing cask vendor has the methodology to theoretically ensure there is no damage to the canister or overpack. Upon review of the theoretical analyses, additional prototype testing may be required.

## 7.2 Fuel with Higher Enrichment, Burn-up, and Thermal Loading

Technology also exists that provides insight to the results on the canister and over pack when exposed to higher burn-up fuels. Testing can also be performed to verify the results of the theoretical analysis. The disposable canister will be designed to accommodate fuel that has a burn-up of 60 GWD/MTHM, 4% initial enrichment for shielding calculations, and 5% initial enrichment for criticality calculations. The design will assume a heat output of 1,185 watts per pressurized water reactor assembly or 435 watts per boiling water reactor assembly.

The drop height analyses and impacts to higher burn-up fuel are included in site specific requirements specified in *Confirmation Report-Yucca Mountain CSNF Aging Casks* (BSC 2005 [DIRS 173420]). The higher enrichment, burn-up values, and drop heights are included in *Specification for the Procurement of Yucca Mountain Aging Casks* (TriVis 2005 [DIRS 173486]).

## 8. EXPECTED RESULTS AND SUCCESS CRITERIA

The following section outlines the expected results and success criteria based on satisfying the ITS performance requirements specified within the NSDB (BSC 2005 [DIRS 171512]). Deviations reported to these expectations should be subject to close inspection or further evaluation. If necessary, prototype testing may be required to verify calculation results. The *Nuclear Safety Design Bases for License Application* contains nuclear safety requirements for a dual purpose canister and site-specific cask. They include nuclear safety requirements for dual purpose canisters, site-specific casks, safety functions that ITS systems must perform, and drop height requirements (BSC 2005 [DIRS 171512], p. A-31, p. A-53, Appendix B, and Appendix C respectively).

### 8.1 Nuclear Safety Testing

The confirmation of requirement satisfaction will occur by evaluating properties of individual disposable canisters and overpack systems compared to Category 2 event sequences to ensure radiation exposure levels shall not be exceeded. Table 8-1 is a summary of the primary NSDB requirements that have been established. Satisfaction of the NSDB requirements will be accomplished by implementation of planning, testing, analysis, verification, reviewing, demonstration, inspection, and other methods that will be accomplished in accordance with *Quality Assurance Requirements and Description* (DOE 2004 [DIRS 171539]).

Table 8-1. Nuclear Safety Design Basis Requirements

Number	Derived From NSDB Performance Requirements	Verification Method
1	In the event of a credible fire, the wall temperature of a disposable canister, within an overpack being handled or at rest, shall not exceed the allowable operating range (based on BSC 2005 [DIRS 171512], p. A-31).	This will be verified with calculations benchmarking existing calculations performed for previously licensed canisters and overpacks.
2	Disposable canisters within an overpack shall not breach as a result of a credible fire (based on BSC 2005 [DIRS 171512], p. A-31).	This will be verified with calculations benchmarking existing calculations performed for previously licensed canisters and overpacks.

Number	Derived From NSDB Performance Requirements	Verification Method
3	Disposable canisters shall be designed to ensure nuclear criticality safety with optimum moderation and the most reactive waste forms (based on BSC 2005 [DIRS 171512], p. A-31).	This will be verified with calculations benchmarking existing calculations performed for previously licensed canisters and overpacks.
4	The contents of the disposable canisters shall be maintained in a criticality safe configuration despite any geometric rearrangement due to a drop or other handling incident (based on BSC 2005 [DIRS 171512], p. A-31).	This will be verified with calculations benchmarking existing calculations performed for previously licensed canisters and overpacks.
5	The disposable canister system shall be designed and transported such that any credible drop or collision does not result in a breach of the canister (based on BSC 2005 [DIRS 171512], p. A-53).	This will be verified with calculations benchmarking existing calculations performed for previously licensed canisters and overpacks. Operational procedures will be established to ensure the calculation results are maintained
6	The canister system shall maintain confinement during design basis ground motion-2 seismic events (based on BSC 2005 [DIRS 171512], p. A-53).	This will be verified with calculations benchmarking existing calculations performed for previously licensed canisters and overpacks.
7	Tip-over of a canister system as a result of being struck by a design basis tornado missile will not occur nor will a loss of confinement (based on BSC 2005 [DIRS 171512], p. A-53).	This will be verified with calculations benchmarking existing calculations performed for previously licensed canisters and overpacks.
8	Tip-over of a canister system as a result of extreme wind or tornado events will not occur (based on BSC 2005 [DIRS 171512], p. A-53).	This will be verified with calculations benchmarking existing calculations performed for previously licensed canisters and overpacks.
9	The design of the canister system shall ensure that they can withstand the differential pressure associated with a passing tornado without loss of confinement (based on BSC 2005 [DIRS 171512], p. A-53).	This task will be performed with calculations benchmarking existing calculations performed for previously licensed canisters and overpacks.
10	Short-duration vent blockage events involving the disposable canister and overpack system shall be precluded (based on BSC 2005 [DIRS 171512], p. A-53).	This task will be verified with calculations benchmarking existing calculations performed for previously licensed canisters and overpacks to determine the limitations. Operational procedures will be instituted to ensure the calculated limits are not exceeded.
11	The design of the canister system shall ensure that welded closure confinement system design precludes loss of confinement following closure of the casks to meet life cycle operations (based on BSC 2005 [DIRS 171512], p. A-53).	This will be verified with calculations benchmarking existing calculations performed for previously licensed canisters and overpacks.
12	The disposable canister and overpack system shall not lose their intended function under conditions involving the maximum snow, sand, or ash loads (based on BSC 2005 [DIRS 171512], p. A-53).	This will be verified with calculations benchmarking existing calculations performed for previously licensed canisters and overpacks. Operational procedures will be created to ensure boundaries established by the calculations are maintained.
13	The design of the canister system shall ensure that the bolted closure design, if applicable, protects seals from damage following closure to maintain its primary confinement boundary function to meet life cycle operations (based on BSC 2005 [DIRS 171512], p. A-53).	This will be verified with calculations benchmarking existing calculations performed for previously licensed canisters and overpacks. The operational procedures will ensure monitoring of the internal pressures so the calculated limits are maintained.

Number	Derived From NSDB Performance Requirements	Verification Method
14	In the event of a credible fire, the wall temperature of a loaded canister system with docking ring installed shall not exceed its allowable operating range (based on BSC 2005 [DIRS 171512], p. A-54).	This will be verified with calculations benchmarking existing calculations performed for previously licensed canisters and overpacks.  (This will include dry versus wet fuel transfer.)
15	Disposable canisters and overpacks shall permit sufficient heat convection to maintain commercial SNF at the appropriate temperature during extreme temperature events at the repository (based on BSC 2005 [DIRS 171512], p. A-53).	This will be verified with calculations benchmarking existing calculations performed for previously licensed canisters and overpacks.

Additionally, given the requirement to place disposable canisters in waste packages for emplacement, an evaluation of the requirements listed in *Requirements for the Site-Specific Canister/Basket* (BSC 2005 [DIRS 172973]) will be performed. The calculations will be conducted for canisters designed for PWR and BWR fuel assemblies.

## 9. LOGIC TIES FOR FUTURE ACTIVITIES

Activities for the disposable canister and overpack system have been established to guide implementation of the program. The activities and schedule are presented in Appendix C. Logic ties to the Design Engineering, Procurement, and Construction organizations are identified in Table C-1. The ties correspond to the major design development milestones of the YMR canister system. All major activities for implementation of the disposable canister program, such as requirements development, design calculations, specification development, and procurement are included in Appendix C.

## 10. CONCLUSIONS

This plan identifies a means to confirm that there are no significant technical gaps between current designs for a disposable canister (the Yucca Mountain waste package and commercial DPCs), currently designed commercial overpacks, and the proposed disposable canister and overpack system at Yucca Mountain. After completion of the operational performance report and the external event report being prepared per *Confirmation Report-Yucca Mountain CSNF Aging Casks* (BSC 2005 [DIRS 173420]) specific modification will be highlighted.

This plan also identifies the means to demonstrate that current technologies used to license the existing aging casks and overpacks systems can be used to design new disposable canisters and overpacks systems in accordance to 10 CFR 63 [DIRS 173273]. This plan discusses that no significant technical gaps between current designs and the proposed new disposable canisters and overpacks apparent. An evaluation of drop heights and handling conditions at Yucca Mountain will be needed since the repository design for handling waste varies from what is currently practiced at nuclear utilities. The logic for future activities presented in Section 9.0 represents a path forward for successful implementation of disposable canisters.

Development of disposable canisters is primarily identified in *Confirmation Report-Yucca Mountain CSNF Aging Casks* (BSC 2005 [DIRS 173420]) and *Engineering Services, SNF Aging Casks/Site-Specific Casks* [BSC 2004 [DIRS 172746]]. These activities, in addition to the work

performed in *Evaluation of 10 CFR 72 Licensed Casks for Use in Aging Spent Nuclear Fuel* (Buchheit 2004 [DIRS 172766]), provide a firm basis for proceeding with the logic outlined in Section 9.0 and Appendix C.

## 11. REFERENCES

- 163274 NRC (U.S. Nuclear Regulatory Commission) 2003. *Yucca Mountain Review Plan, Final Report*. NUREG-1804, Rev. 2. Washington, D.C.: U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards. TIC: 254568.
- 168494 HOLTEC International. 2002. *Final Safety Analysis Report for the Holtec International Storage and Transfer Operation Reinforced Module Cask System (Hi-Storm 100 Cask System)*. HOLTEC Report HI-2002444. Two volumes. NRC Docket No. 72-1014. Marlton, New Jersey: HOLTEC International. TIC: 255899.
- 168862 LP-ENG-014-BSC, Rev. 0, ICN 2. *Engineering Studies*. Washington, D.C.: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. ACC: DOC.20040225.0003.
- 169235 Gutherman, B. 2003. "USNRC Docket No. 71-9261, HI-STAR 100 Certificate of Compliance 9261, Submittal of HI-STAR 100 Safety Analysis Report, Revision 10." Letter from B. Gutherman (Holtec) to U.S. Nuclear Regulatory Commission, August 21, 2003, with enclosures. TIC: 255249.
- 169308 BSC (Bechtel SAIC Company) 2004. *Shielding Evaluation for Spent Nuclear Fuel Aging Areas*. 170-00C-HAP0-00200-000-00A. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20040512.0002.
- 171190 BSC (Bechtel SAIC Company) 2005. *Q-List*. 000-30R-MGR0-00500-000-001. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20050217.0010.
- 171512 BSC (Bechtel SAIC Company) 2005. *Nuclear Safety Design Bases for License Application*. 000-30R-MGR0-00400-000-001. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20050308.0004.
- 171539 DOE (U.S. Department of Energy) 2004. *Quality Assurance Requirements and Description*. DOE/RW-0333P, Rev. 16. Washington, D.C.: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. ACC: DOC.20040907.0002.
- 171589 BSC (Bechtel SAIC Company) 2004. *Aging Facility Criticality Safety Calculations*. 170-00C-HA00-00100-000-00B. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20040910.0027.

- 171923 LP-SI.11Q-BSC, Rev. 0, ICN 1. *Software Management*. Washington, D.C.: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. ACC: DOC.20041005.0008.
- 172109 BSC (Bechtel SAIC Company) 2005. *SNF Aging System Description Document*. 170-3YD-HA00-00100-000-004. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20050406.0014.
- 172174 BSC (Bechtel SAIC Company) 2005. *Site Fire Hazard Analysis*. 000-30R-PF00-00100-000-00B. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20050119.0001.
- 172395 Womack L.F. 2001. "Docket No. 72-26, Diablo Canyon Independent Spent Fuel Storage Installation, Submittal of Non-Proprietary Calculation Packages." Letter from L. F. Womack (PG&E) to U.S. Nuclear Regulatory Commission, December 21, 2001, PG&E Letter DIL-01-004, with enclosure. TIC: 256634.
- 172746 BSC (Bechtel SAIC Company) 2004. Engineering Services, SNF Aging Casks/Site-Specific Casks. 170-3SW-WA42-00100-000-001. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20040915.0005; MOL.20041111.0116.
- 172766 Buchheit, J.M. 2004. *Evaluation of 10 CFR 72 Licensed Casks for Use in Aging Spent Nuclear Fuel*. COGEMA-C0115-RP-04-001, Rev. 1. Las Vegas, Nevada: Cogema. ACC: ENG.20050124.0051.
- 172973 BSC (Bechtel SAIC Company) 2005. *Requirements for the Site-Specific Canister/Basket*. 000-30R-HA00-00400-000-000. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20050309.0002.
- 173167 BSC (Bechtel SAIC Company) 2005. *Aging Facility Worker Dose Assessment*. 170-00C-HA00-00200-000-00A. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20050324.0004.
- 173202 BSC (Bechtel SAIC Company) 2005. *21-PWR Site-Specific Canister/Basket Detail Drawing Assembly Exploded View [Sheet 2]*. 000-M00-HA00-00102-000-00A. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20050325.0002.
- 173273 10 CFR 63. 2005 Energy: Disposal of High-Level Radioactive Wastes in a Geologic Repository at Yucca Mountain, Nevada. ACC: MOL.20050405.0118.
- 173336 10 CFR 72. 2005 Energy: Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor-Related Greater than Class C Waste. ACC: MOL.20050411.0074.
- 173420 BSC (Bechtel SAIC Company) 2005. *Confirmation Report-Yucca Mountain CSNF Aging Casks*. 170-3SW-WA42-00200-000 REV 001. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20050321.0003.

- 173486      TriVis 2005. *Engineering Specification for the Procurement of Yucca Mountain Aging Casks*. 05-002-167, Rev C (Draft). Las Vegas, Nevada: TriVis.
- 173779      Cogema. 2004. Aging Cask Study Submittal Item 1.1.1C, Letter Report - Evaluation on NRC Licensed Spent Fuel Storage Cask Systems with Respect to YMP Requirements. COGEMA-C0115-04-046. Las Vegas, Nevada: Cogema. ACC: ENG.20040415.0003.

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## Appendix A. Glossary

### **Aging Cask**

A generic term for a component or combination of components that confines commercial spent nuclear fuel and provides a heat transfer path, criticality control, radioactive shielding, and environmental protection under normal, off-normal, and accident conditions of aging. This includes:

- A cask, with integral shielding and an internal basket assembly, containing uncanistered commercial spent nuclear fuel.
- A commercial dual-purpose canister in a metal or concrete overpack.
- A repository site-specific disposable canister in a metal or concrete overpack (the subject of this design development plan).
- A dual-purpose canister in a horizontal aging module.

### **Bare Fuel**

Spent nuclear fuel that has not been encased in a confinement vessel such as a canister.

### **Basket Assembly**

The internal support and fuel assembly positioning structure placed within a cask or canister cavity that provides a heat transfer path and criticality control under normal, off-normal, and accident conditions of storage, transportation, and/or aging.

### **Crawler**

A track type transporter designed to move a concrete or metal overpack containing a Yucca Mountain repository disposable canister to and from the waste handling facilities and the aging pads.

### **Disposable Canister**

A relatively thin-walled metal vessel, with an internal basket assembly, designed to confine commercial spent nuclear fuel assemblies and provide a heat transfer path and criticality control under normal, off-normal, and accident conditions while aging and transferring at the repository. Repository disposable canisters are suitable for eventual placement in waste packages and subsurface emplacement.

### **Dual-Purpose Canister**

A canister, loaded with spent nuclear fuel at a commercial utility, that is used for both storage and transportation of spent nuclear fuel. Currently, commercial dual-purpose canisters are

not certified for underground emplacement and disposal.

**Gap Analysis**

An evaluation of design inputs that includes requirements, codes, and standards to identify missing elements that are not currently used in nuclear facilities. An analysis of the gaps in the entire design when compared to existing designs.

**Handling Cask**

A transfer cask utilized at the waste handling facilities to facilitate disposable canister transfers and lower radiological exposures to facility workers.

**Nonstandard SSC**

Items identified through a gap analysis that have requirements placed on them that have not been applied to current components in the nuclear industry.

**Overpack**

A concrete or metal, vertically oriented, right circular cylinder that provides structural protection, radiological shielding, and environmental protection to an internal canister. The overpack functions in tandem with the disposable canister to hold spent nuclear fuel at an aging pad.

**Overpack System**

A designed system that includes the overpacks and the disposable canisters.

**Standard SSC**

Items currently in use at nuclear facilities that were developed to existing codes and standards.

## Appendix B. Prototype Testing and Data Acquisition Plan

Prototype testing can ensure that various SSCs associated with the canister system will perform their intended safety functions. Table B-1 is a brief summary of the ITS items that may be tested and the physical condition that the test is intended to address. The testing and data acquisition will assure conformance with the NSDB performance requirements in Table 8-1.

Table B-1. Prototype Testing and Data Acquisition Plan for ITS Structures, Systems, and Components

Nuclear Safety Requirement From Table 8-1	Item	Physical Condition
3, 4, 5, 6, 7, 8,	Disposable Canister	Drop, impact, and slapdown
9, 11, 12, 13, 14	Disposable Canister Seal	Pressure and confinement
1, 2, 14	Disposable Canister	Fire exposure
10, 15	Overpack System	Thermal performance
7, 8, 12,	Concrete Overpack	Drop, impact, and slapdown
1, 2	Concrete Overpack	Fire exposure
10, 15	Concrete Overpack	Thermal performance
7, 8, 12,	Metal Overpack	Drop, impact, and slapdown
1, 2	Metal Overpack	Fire exposure
10, 15	Metal Overpack	Thermal performance

Note. See the Glossary in Appendix A for a definition of terms.

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## Appendix C. Design Logic Ties

Table C-1. Canister System Design Development Milestones

Design Development Milestone	Description	P3 Logic ID	P3 Logic Description	Target Completion Date
Commercially Available Cask and Overpack Systems				
Prepare and issue scope of work to direct 10 CFR 72 license holders to evaluate existing casks and overpacks systems to site-specific requirements	Request from existing cask and overpack system manufacturers to determine how existing casks respond to site-specific requirements	RPTAP005	Develop Office of National Transportation Aging Cask Scope of Work	Completed
		RPTAP011	Issue Cask Scope of Work to Office of National Transportation	Completed
Prepare and issue scope of work to direct 10 CFR 72 license holders to evaluate drop height impacts on existing DPCs	Request from existing vendors acceptable drop height boundaries	TBD	TBD	TBD
Receive from cask vendors a letter stating how existing casks and overpacks systems respond to site-specific requirements	Cask vendors to provide insight as to how existing casks and overpacks systems respond to site specific requirements	RPTAP014	Non-Cogema Vendor Prepared Office of National Transportation Cask Confirmation Letter	06/20/2005
Evaluate Vendor Confirmation Letters	Evaluate data (confirmation letters) from cask vendors that provided insight as to how existing casks and overpacks systems respond to site specific requirements.	RPTAP016	Evaluate Office of National Transportation Cask Confirmation Letter	07/05/2005

Design Development Milestone	Description	P3 Logic ID	P3 Logic Description	Target Completion Date
Revise existing scope of work for more detail on how existing casks and overpacks systems respond to site-specific requirements	Continue the evaluation by existing cask and overpack system suppliers to confirm acceptability or adaptability to satisfy site-specific requirements	RPTAP021	Office of National Transportation Revises Vendor Scopes of Work	06/20/2005 (EST)
		RPTAP0412	Office of National Transportation Vendor Criticality Calculation – Aging Cask	10/15/2005 (EST)
		RPTAP0413	Office of National Transportation Vendor Structural Calculation – Aging Cask	10/15/2005 (EST)
		RPTAP0414	Office of National Transportation Vendor Shielding Calculation – Aging Cask	10/15/2005 (EST)
Confirm technical basis	Perform technical audit of vendor supplied calculations	TBD	TBD	11/15/05(EST)
Update SAR section	Revise SAR as required to incorporate results of calculations.	RPTAP0314	Provide SAR 1.2.7 (2 <sup>nd</sup> Update – Site Specific Disposable Canister)	5/10/06 (EST)
Disposable Canister and Overpack System				
Complete Requirements for the Disposable Canister System	Develop a requirements document for the disposable canister and overpack system.	RPTNCY0115	Requirements – Site Specific Canister/Basket	Completed
Complete Disposable Canister System Conceptual Design	Develop a conceptual design of the disposable canister and overpack system based on the established requirements.	RPTNCY011	Conceptual Design – Site Specific Canister/Basket	Completed

Design Development Milestone	Description	P3 Logic ID	P3 Logic Description	Target Completion Date
Conduct Disposable Canister Preliminary Studies	Conduct preliminary studies of the thermal, structural, shielding, and criticality portions of the Yucca Mountain disposable canister conceptual design.	RPTNCY0200	Thermal Study – Site Specific Canister/Basket	Completed
		RPTNCY0204	Structural Study – Site Specific Canister/Basket	Completed
		RPTNCY0206	Shielding Study – Site Specific Canister/Basket	Completed
		RPTNCY0211	Criticality Study – Site Specific Canister/Basket	Completed
Complete Disposable Canister Preliminary Drawings	Complete a set of preliminary drawings of the disposable canister and overpack system that advances the conceptual design.	RPTNCY0208	Preliminary Drawings – Site Specific Canister/Basket	Completed
Complete Preliminary Calculations for the Disposable Canister System	Complete preliminary thermal, criticality, structural, and shielding calculations of the disposable canister, basket, and overpack systems	RPTNCY0110	Preliminary Thermal Calculations – Site Specific Canister/Basket	06/30/2005
		RPTNCY0111	Preliminary Criticality Calculations – Site Specific Canister/Basket	Completed
		RPTNCY0112	Preliminary Structural Calculations – Site Specific Canister/Basket	Completed
		RPTNCY0113	Preliminary Shielding Calculations – Site Specific Canister/Basket	Completed

Design Development Milestone	Description	P3 Logic ID	P3 Logic Description	Target Completion Date
Revise Preliminary Drawings of Disposable Canister	Complete revision of drawings of the preliminary design based on the criticality, structural, shielding, and thermal calculations as follow-on work to the preliminary drawings.	RPTNCY0114	Preliminary Drawings Revision – Site Specific Canister/Basket	06/30/2005
Issue Disposable Canister Design Specification	Develop and finalize the specifications for a disposable canister and overpack system at Yucca Mountain.	RPTNCY0321	Issue Canister System Design Specification	08/02/2005
Prepare, Issue, and Evaluate Disposable Canister Request for Proposal (RFP)	Prepare an RFP package, pre-qualify vendors, and initiate the procurement process to acquire a canister system design vendor. Receive the disposable canister design proposals. Evaluate the disposable canister design proposals.	RPTNCY033	Prepare and Issue Canister System Design RFP	02/01/2006
		RPTNCY034	Receive Canister System Design Bids	04/01/2006
		RPTNCY035	Evaluate Canister System Design Quotes	05/01/2006
Award Canister Subcontract	Award a design subcontract for the YMR disposable canister, handling cask (if needed), and overpack system.	RPTNCY041	Award Canister System Design Subcontract	06/01/2006
Subcontractor Design of Disposable Canister System	Complete the disposable canister system final design.	RPTNCY051	Canister System Design Subcontract Performance	06/01/2007
Submit License Application per 10 CFR 63 for Disposable Canister	Submit an amendment to license application to the NRC for the final disposable canister system.	RPTNCY400	Canister Vendor Design – License Application 10 CFR 63 License	01/01/2009
Fabricate Canisters	Procure, and fabricate the disposable canister system components at the repository.	RPTNCY500	Fabricate and Deliver Canisters	04/22/2010
Receipt Canisters	Receive, and inspect the disposable canister system components at the repository.	RPTNCY500	Fabricate and Deliver Canisters	04/22/2011
Conduct start-up activities/testing as required	Perform start-up activities for disposable canister system activities	TBD	TBD	TBD

Design Development Milestone	Description	P3 Logic ID	P3 Logic Description	Target Completion Date
Prepare and issue scope of work to direct 10 CFR 72 license holders to evaluate existing casks and overpacks systems to site-specific requirements	Request from existing cask and overpack system manufacturers to determine how existing casks respond to site-specific requirements	RPTAP005	Develop Office of National Transportation Aging Cask Scope of Work	Completed
		RPTAP011	Issue Cask Scope of Work to Office of National Transportation	Completed
Receive from cask vendors a letter stating how existing casks and overpacks systems respond to site-specific requirements	Cask vendors to provide insight as to how existing casks and overpacks systems respond to site specific requirements	RPTAP014	Non-Cogema Vendor Prepared Office of National Transportation Cask Confirmation Letter	06/20/2005
Evaluate Vendor Confirmation Letters	Evaluate data (confirmation letters) from cask vendors that provided insight as to how existing casks and overpacks systems respond to site specific requirements.	RPTAP016	Evaluate Office of National Transportation Cask Confirmation Letter	03/17/2005
Revise existing scope of work for more detail on how existing casks and overpacks systems respond to site-specific requirements	Continue the evaluation by existing cask and overpack system suppliers to confirm acceptability or adaptability to satisfy site-specific requirements	RPTAP021	Office of National Transportation Revises Vendor Scopes of Work	06/20/2005 (EST)
		RPTAP0412	Office of National Transportation Vendor Criticality Calculation – Aging Cask	10/15/2005 (EST)
		RPTAP0413	Office of National Transportation Vendor Structural Calculation – Aging Cask	10/15/2005 (EST)
		RPTAP0414	Office of National Transportation Vendor Shielding Calculation – Aging Cask	10/15/2005 (EST)

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## Appendix D. Current Disposable Canister Drawings

Drawings illustrating the current conceptual canister design are listed in Table D-1.

Table D-1. Summary of Disposable Canister Drawings

Document Title	Document Identifier	Effective Date
21-PWR Site-Specific Canister/Basket General Notes and Drawing Index	000-M00-HA00-00101-000-00A	March 24, 2005
21-PWR Site-Specific Canister/Basket Detail Drawing Assembly Exploded View	000-M00-HA00-00102-000-00A	March 24, 2005
21-PWR Site-Specific Canister/Basket Canister Shell Detail Drawing	000-M00-HA00-00103-000-00A	March 24, 2005
21-PWR Site-Specific Canister/Basket Guide Location and Orientation	000-M00-HA00-00104-000-00A	March 24, 2005
21-PWR Site-Specific Canister/Basket Side, End Side and Corner Guides Detail Drawing	000-M00-HA00-00105-000-00A	March 24, 2005
21-PWR Site-Specific Canister/Basket Fuel Basket Assembly Detail Drawing	000-M00-HA00-00106-000-00A	March 24, 2005
21-PWR Site-Specific Canister/Basket Fuel Tube Assembly Detail Drawing	000-M00-HA00-00107-000-00A	March 24, 2005
21-PWR Site-Specific Canister/Basket Shield & Inner Seal Plug Detail Drawing	000-M00-HA00-00108-000-00A	March 24, 2005
21-PWR Site-Specific Canister/Basket Spread Ring & Filler Segment Detail Drawing	000-M00-HA00-00109-000-00A	March 24, 2005
21-PWR Site-Specific Canister/Basket Outer Seal Plate & Plug Detail Drawing	000-M00-HA00-00110-000-00A	March 24, 2005
21-PWR Site-Specific Canister/Basket Miscellaneous Assembly Details	000-M00-HA00-00111-000-00A	March 24, 2005

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## Appendix E. Design Development Plan Acceptance and Completion Criteria

The acceptance and completion criteria established for this plan are listed in Table E-1. Descriptions of the criteria and the locations in this plan where satisfaction of the criteria is demonstrated are included.

Table E-1. Repository Canister System Design Development Plan Acceptance and Completion Criteria

Criteria from Deliverable Definition Sheet		Satisfaction Description
1.	Plan shall be prepared, checked, approved, and distributed in accordance with procedure LP-ENG-014-BSC, <i>Engineering Studies</i> .	Plan was prepared in accordance with stated procedure (Section 3).
2.	Plan shall be consistent with requirements and guidance established within 10 CFR 63 [DIRS 173273] and NUREG-1804 (NRC 2003 [DIRS 163274]).	Plan scope is consistent with stated documents (Section 2).
3.	Plan and associated gap analysis shall identify ITS and important to waste isolation safety functions that are expected to be met by nonstandard SSCs.	Plan has identified that no nonstandard SSCs are associated with the repository disposable canister and overpack system (Section 5).
4.	Plan shall define the necessary design development requirements, including calculations, analyses and testing, to demonstrate that safety functions can be achieved as required.	Analysis and testing activities are presented in Section 6 and in Section 8.
5.	Plan shall provide a description of each test or development activities.	Activities are described in Section 6.
6.	Plan shall describe information/data collection and inspection requirements.	Plan information and data requirements are presented in Section 7.
7.	Plan shall describe expected results and success criteria that will be used for performance acceptance.	Expected results and success criteria are presented in Section 8.
8.	Plan shall identify logic ties to engineering, procurement, and construction for availability of information and inspections and performance acceptance activities.	Logic ties are explained in Section 9 and Appendix C.

Note: Based on letter Arthur to Mitchell, June 2, 2005, BSC Correspondence Log # 0602055754.

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